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HOT WATER AND FUNGICIDES FOR CONTROL OF MOLD ON CANTALOUPS

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CONTENTS

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Hot Water and Fungicides for Control Of Mold On Cantaloups

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SUMMARY

Cantaloups dipped for 30 seconds in 130° or 135° F. water or in fungicide solutions heated to 130° or 135° had less stem-scar and surface mold than those dipped in 75° water or in 75° fungicide solutions. Maneb (manganese ethylenebis[dithiocarbamate]) at 360 and 719 p.p.m., SDMC (sodium dimethyldithiocarbamate) at 2,500 and 5,000 p.p.m., and captan (*N*-[(trichloromethyl)thio]-4-cyclohexene-1,2-dicarboximide) at 300 and 600 p.p.m. were equally effective in controlling mold growth at either of the two concentrations.

Hot water alone was more effective in controlling stem-scar mold than were the fungicides applied at 75° F., and it was as effective in controlling both stem-scar and surface mold as the heated fungicides.

Flood or immersion treatments with hot water or hot fungicide solutions were equally effective in controlling mold.

Experimental hot water or heated fungicide solutions controlled mold significantly better than the decay-control methods currently being used in commercial packing sheds.

Melon quality was evaluated after holding the cantaloups for 7 days at 45° F. plus 3 days at 70°.

INTRODUCTION

The California Crop and Livestock Reporting Service indicated that the value of the 1970 California cantaloup crop was about $50 million. Marketing losses have been reported to range from 0 to 50 percent and to average about 3 percent, which would amount to about $1.5 million annually. Most of these losses are due to decay (*7*),[1] even though the melons are treated with a fungicide in the packinghouse before shipment to market.

Recent studies (*2, 4, 5, 6, 8*) show that hot water or hot water plus a fungicide effectively reduce decay on cantaloups. In this report, hot water, solutions of different fungicides, and two methods of applying these materials were compared with commercial treatments for decay control.

MATERIALS AND METHODS

'Powdery Mildew Resistant 45' cantaloups grown commercially in the San Joaquin Valley of California were selected for decay-control studies during the summer of 1969. The melons were "hard ripe" to "eastern choice" maturity and most were size 36. The tests were replicated five times during the season. Each treatment lot consisted of nine melons. The melons were dipped for 30 seconds in water or in a

[1] Italic numbers in parentheses refer to Literature Cited, p. 6.

fungicide solution at 75°, 130°, and 135° F. The fungicides tested were maneb (manganese ethylenebis[dithiocarbamate]), SDMC (sodium dimethyldithiocarbamate), and captan (*N*-[trichloromethyl)thio]-4-cyclohexene-1,2-dicarboximide), all of which are approved for use on cantaloups by the U.S. Environmental Protection Agency.

Each fungicide was tested at two concentrations, which were a fraction of those recommended for commercial use at normal temperatures. Maneb was tested at 0, 360, and 719 p.p.m., SDMC at 0, 2,500 and 5,000 p.p.m., and captan at 0, 300, and 600 p.p.m. The lower concentration of each fungicide will be referred to as level 1 and the higher concentration as level 2. Level 0 refers to water treatments containing no fungicide.

Dip and flood treatments for 30 seconds with hot water or hot captan also were compared. The immersion procedure has been described (*6*). The flooding method consisted of showering the melons with the water or fungicide solution at a rate of 15 gallons per minute per square foot area in a treatment chamber.

The efficacy of standard commercial treatments for decay control was compared with that of the experimental hot water and heated fungicide (at level 1) treatments. The commercial treatments in four of the sheds consisted of 20,000 p.p.m. of SOPP (sodium orthophenylphenate) applied in a wax spray at ambient temperature. In a fifth shed, 20,000 p.p.m. of SDMC was used instead of SOPP. The results in all five sheds were averaged together for comparison with the experimental results.

Holding conditions for treated melons were 7 days at 45° F. plus 3 days at 70° (±2°) to simulate transit and wholesale-retail conditions. The melons were covered with polyethylene bags during both holding periods to provide high relative humidity and to encourage fungal growth. The bags were open at one end to prevent atmosphere modification.

Quality evaluations were made by rating each melon for stem-scar mold, surface mold, vein-tract (suture) browning, and general appearance after the second holding period (*1*). These and other defects developing during holding, such as sunken areas, were considered in the ratings for general appearance. However, these ratings were primarily affected by mold growth. The rating scale for stem-scar mold, surface mold, and vein-tract browning was 1, none; 2, trace; 3, slight; 4, moderate; and 5, severe. The rating scale for general appearance was 1, unsalable; 2, poor; 3, fair; 4, good; and 5, excellent. Since so little vein-tract browning developed, these results are not presented.

All data were treated by analysis of variance. In table 1, section A, they were based on a split-split plot experimental design, whereas the data for section B and for the results in table 2 were based on a two-way analysis. Differences were evaluated by Duncan's multiple range tests.

RESULTS

Temperature

The water and fungicide treatments at 130° and 135° F. significantly reduced the incidence of stem-scar mold as compared with treatments at 75° (table 1). Only 2.4 to 3.7 percent of the melons rated 3.0 or greater and treated at the higher temperatures developed stem-scar mold, whereas 33.1 percent of the melons so rated and treated at 75° developed mold. There was no significant difference in the incidence of stem-scar mold between the lots treated at 130° or 135°.

Severity of stem-scar mold as indicated by the ratings also was significantly lower among the melons treated at 130° or 135° F. than among those treated at 75°. Average severity ratings were about 1.3 for the former and 2.3 for the latter.

The heat treatments similarly reduced the incidence of surface mold. About 2 percent or less of the melons rated 3.0 or greater and treated at 130° or 135° F. had surface mold, whereas over 13 percent of those so rated and treated at 75° had this mold. Differences in the incidence of surface mold between the melons treated at the higher temperatures were not

significant. Average severity ratings for surface mold also were significantly less for the heat-treated melons than for those treated at 75°.

The general appearance of the heat-treated melons was significantly better than that of the melons treated at 75° F., primarily because the heat helped control mold. The average appearance rating of the melons treated at 130° or 135° was "good," whereas it was "fair" for melons treated at 75°. Furthermore, almost 70 percent of the melons treated at 130° or 135°

TABLE 1.—*Effect of various treatments on 2 molds and on general appearance of cantaloups held 7 days at 45° plus 3 days at 70° F.*[1]

Treatment	Melons with stem-scar mold		Melons with surface mold		General appearance	
	Average severity	Melons rated 3.0 or greater [2]	Average severity	Melons rated 3.0 or greater [2]	Average rating	Melons rated 4.0 or greater
	Rating [3]	*Percent*	*Rating* [3]	*Percent*	*Rating* [4]	*Percent*
Section A [5]						
Temperature of water and fungicide solutions (° F.):						
75	2.3 b	33.1 b	1.5 b	13.6 b	3.3a	40.2a
130	1.3a	3.7a	1.1a	2.4a	4.0 b	65.7 b
135	1.2a	2.4a	1.1a	.4a	4.0 b	69.3 b
Fungicide:						
Maneb	1.7a	15.8a	1.3a	8.7a	3.6a	53.8a
SDMC	1.3a	6.4a	1.1a	2.4a	3.8a	59.8a
Captan	1.7a	17.1a	1.3a	5.4a	3.8a	61.8a
Fungicide concentration: [6]						
Level 0	1.[illegible] b	18.8 b	1.4 b	10.7 b	3.6a	50.3a
Level 1	1.5a	10.3a	1.1a	2.7a	3.8ab	60.2 b
Level 2	1.5a	10.1a	1.2a	3.2a	3.9 b	64.7 b
Heat method with captan:						
Immersion	1.7a	17.0a	1.3a	5.4a	3.8a	61.8a
Flood	1.5a	15.1a	1.2a	5.2a	3.7a	55.8a
Section B						
130° F. water only	1.4a	20.0a	1.1a	4.4a	3.8 b	60.0a
135° F. water only	1.2a	13.3a	1.1a	8.9a	4.1 b	66.7a
130° F. water with—						
360 p.p.m. maneb	1.2a	13.3a	1.1a	2.2a	3.7 b	48.9a
2,500 p.p.m. SDMC	1.1a	4.4a	1.0a	0 a	4.1 b	68.9a
300 p.p.m. captan	1.4a	17.8a	1.1a	6.7a	4.2 b	82.2a
Commercial treatments [7]	2.2 b	60.0 b	1.3a	17.8a	3.0a	26.7a

[1] Means within a vertical group of 3 (or 2) (section A) or 6 (section B) not followed by same letter are significantly different at 5-percent level.

[2] For treatments in section B, melons rated 2.0 or greater.

[3] 1 = none, 2 = trace, 3 = slight, 4 = moderate, 5 = severe.

[4] 1 = unsalable, 2 = poor, 3 = fair, 4 = good, 5 = excellent.

[5] Data for temperature effects are averages of 3 fungicides and 3 fungicide concentrations; data for fungicide effects are averages of 3 temperatures and 3 fungicide concentrations; data for fungicide concentration effects are averages of 3 temperatures and 3 fungicides; data for heat method effects are averages of 3 temperatures and 3 concentrations of captan.

[6] Level 0 = water with no fungicide; level 1 = 360, 2,500, and 300 p.p.m. and level 2 = 719, 5,000, and 600 p.p.m. for maneb, SDMC, and captan, respectively.

[7] SOPP or SDMC at 20,000 p.p.m. applied in wax spray at ambient temperature.

were rated "good" for general appearance, whereas only 40 percent of the melons treated at 75° were rated this high. These results are consistent with those reported earlier (*6*).

Fungicide

The specific fungicide used had no significant effect on the average severity rating for stem-scar mold or on the percentage of melons with stem-scar mold (table 1).

The degree of surface mold development also was not significantly different among melons treated with any of the three fungicides.

Similarly the appearance of the melons was not significantly affected by the fungicide used. The percentage of melons rated "good" or better for general appearance ranged from 53.8 to 61.8 percent among the three fungicides and average ratings for general appearance were essentially the same.

Fungicide Concentration

Stem-scar mold was significantly affected by the concentration of the fungicides tested. Lots not treated with fungicide (level 0) had almost twice as many melons with stem-scar mold as lots treated with fungicide (levels 1 or 2) (table 1). Average stem-scar ratings also were significantly different between the lots of not treated with fungicide and those treated at the two levels of fungicide. There was no significant difference in stem-scar mold between the melons treated at level 1 and level 2.

About 3 percent of the melons treated with a fungicide had surface mold (rated 3.0 or greater), whereas almost 11 percent of the melons not treated with a fungicide were affected (difference statistically significant). The two levels of fungicides tested were equally effective in controlling surface mold.

Average severity ratings for surface mold also were significantly lower for the fungicide-treated melons than for those receiving no fungicide.

The general appearance of the melons treated with fungicides was better than that of those not treated with a fungicide because the fungicides reduced the incidence of mold. About 60 to 65 percent of the fungicide-treated melons were rated "good" or better, whereas about 50 percent of those not treated with fungicides received this rating (difference statistically significant). General appearance ratings of the melons treated at the two levels of fungicide were not significantly different, but the melons treated with the highest level looked significantly better than those not treated.

Interaction of Temperature and Fungicide Concentration

Hot water alone at 130° or 135° F. was significantly more effective in reducing stem-scar mold than were the fungicides when applied at 75° (table 2). Also, hot water alone was as effective in controlling stem-scar mold as were the fungicides when applied at 130° or 135°. When applied at 75°, the two levels of fungicides were equally effective in controlling stem-scar mold, but they were not as effective as they were at 130° or 135°.

Similar results were obtained with surface mold. The hot water alone was as effective in controlling surface mold as were the fungicides applied at 130° or 135° F. In contrast to the effect on stem-scar mold, surface mold was

TABLE 2.—*Incidence of melons with mold rated 3.0 or greater as affected by temperature and fungicide concentration* [1] [2]

Mold and temperature (° F.)	Melons with mold at indicated fungicide concentration [3]		
	Level 0	Level 1	Level 2
	Percent	*Percent*	*Percent*
Stem-scar mold:			
75	43.7 c	25.9 b	29.7 b
130	6.7a	3.7a	.8a
135	5.9a	1.4a	0 a
Surface mold:			
75	25.2 b	6.7a	8.9a
130	5.6a	1.4a	.8a
135	1.4a	0 a	0 a

[1] Means for each mold not followed by same letter are significantly different at 5-percent level.

[2] Rating scale: 1 = none, 2 = trace, 3 = slight, 4 = moderate, 5 = severe.

[3] Level 0 = water with no fungicide; level 1 = 360, 2,500, and 300 p.p.m. and level 2 = 719, 5,000, and 600 p.p.m. for maneb, SDMC, and captan, respectively.

controlled equally well by hot water alone at 130° and 135° and by fungicides when applied at 75°.

Heat Method

There was no significant difference in stem-scar mold or surface mold between the lots immersed in or those flooded with hot water containing captan for 30 seconds (table 1). About 56 percent of the melons treated by flood were rated "good" or better for appearance and about 62 percent of those treated by immersion were so rated, with no statistically significant difference between the methods.

Experimental Versus Commercial Treatments

Experimental hot water and hot fungicide treatments controlled stem-scar mold significantly better than did the commercial treatments tested. Sixty percent of the commercially treated melons developed stem-scar mold, whereas only about 4 to 20 percent of the experimentally treated melons were affected (table 1). The average severity rating of stem-scar mold also was significantly greater among the commercially treated melons than among the experimentally treated ones.

More than twice as many commercially treated melons had surface mold than the experimentally treated ones, but the differences were not statistically significant. Also, the average rating for surface mold was higher for the melons treated commercially than for those treated experimentally, but the differences were not statistically significant.

The general appearance rating of the commercially treated melons was significantly lower than the ratings of the experimentally treated ones. This was primarily due to the better mold control by the experimental treatments. Only about 27 percent of the commercially treated melons were rated "good" or better for general appearance, whereas about 49 to 82 percent of those treated experimentally were rated this high.

Hot water alone at 130° or 135° F. was as effective in controlling mold on cantaloups as were the 130° solutions containing the lower concentrations (level 1) of the three fungicides tested.

DISCUSSION

Heat treatments at 130° or 135° F. significantly reduced mold of cantaloups compared with controls treated at 75°. This result agrees with previous studies with hot water and fungicides (*6*). The addition of a fungicide to the hot water gave significantly better mold control than hot water alone in the previous studies; in this study it did not. However, a trend in that direction is indicated.

As in previous studies with cantaloups, stem-scar mold was generally more serious than surface mold (*3*).

Maneb, SDMC, and captan were about equally effective in controlling stem-scar and surface mold of cantaloups. If one of the materials is to be used commercially in hot water, the choice should be based primarily on the availability and relative cost of each.

Since the immersion and flood methods were equally effective, the one best suited for the operation of the packinghouse should be selected. Since some cantaloup shippers are already using flood-type hydrocoolers, this same type of equipment modified for heating could be used for the hot water or hot water plus fungicide treatment.

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